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ENID LAKE, YALOBUSHA COUNTY, MISSISSIPPI

PACIFIC NORTHWEST ENVIRONMENTAL RESEARCH
LABORATORY

PREPARED FOR
PACIFIC NORTHWEST ENVIRONMENTAL RESEARCH LABORATORY

JUNE 1975

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16. ABSTRACT

Annual total phosphorus and total nitrogen loadings to the lake were estimated and subdivided according to either point or non-point source origin. An assessment of the lake's trophic condition and limiting nutrient is also provided. All data collected by the U.S.E.P.A. National Eutrophication Survey during the one year study of the lake and its tributaries are included in the report.

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NATIONAL EUTROPHICATION SURVEY

WORKING PAPER SERIES

REPORT
ON
ENID LAKE
YALOBUSHA COUNTY
MISSISSIPPI
EPA REGION IV
WORKING PAPER No. 360

PACIFIC NORTHWEST ENVIRONMENTAL RESEARCH LABORATORY

An Associate Laboratory of the

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and

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REPORT
ON
ENID LAKE
YALOBUSHA COUNTY
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WITH THE COOPERATION OF THE
MISSISSIPPI AIR AND WATER POLLUTION
CONTROL COMMISSION
AND THE
MISSISSIPPI NATIONAL GUARD

JUNE, 1975

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FOREWORD

The National Eutrophication Survey was initiated in 1972 in response to an Administration commitment to investigate the nationwide threat of accelerated eutrophication to fresh water lakes and reservoirs.

OBJECTIVES

The Survey was designed to develop, in conjunction with state environmental agencies, information on nutrient sources, concentrations, and impact on selected freshwater lakes as a basis for formulating comprehensive and coordinated national, regional, and state management practices relating to point-source discharge reduction and non-point source pollution abatement in lake watersheds.

ANALYTIC APPROACH

The mathematical and statistical procedures selected for the Survey's eutrophication analysis are based on related concepts that:

a. A generalized representation or model relating sources, concentrations, and impacts can be constructed.

b. By applying measurements of relevant parameters associated with lake degradation, the generalized model can be transformed into an operational representation of a lake, its drainage basin, and related nutrients.

c. With such a transformation, an assessment of the potential for eutrophication control can be made.

LAKE ANALYSIS

In this report, the first stage of evaluation of lake and watershed data collected from the study lake and its drainage basin is documented. The report is formatted to provide state environmental agencies with specific information for basin planning [§303(e)], water quality criteria/standards review [§303(c)], clean lakes [§314(a,b)], and water quality monitoring [§106 and §305(b)] activities mandated by the Federal Water Pollution Control Act Amendments of 1972.

Beyond the single lake analysis, broader based correlations between nutrient concentrations (and loading) and trophic condition are being made to advance the rationale and data base for refinement of nutrient water quality criteria for the Nation's fresh water lakes. Likewise, multivariate evaluations for the relationships between land use, nutrient export, and trophic condition, by lake class or use, are being developed to assist in the formulation of planning guidelines and policies by EPA and to augment plans implementation by the states.

ACKNOWLEDGMENT

The staff of the National Eutrophication Survey (Office of Research & Development, U. S. Environmental Protection Agency) expresses sincere appreciation to the Mississippi Air and Water Pollution Control Commission for professional involvement and to the Mississippi National Guard for conducting the tributary sampling phase of the Survey.

Glen Wood, Jr., Director, and John Smith, Deputy Director of the Air and Water Pollution Control Commission; and John Harper, Don Scott, John Sigman, and Dwight Wylie of the Water Division provided invaluable lake documentation and counsel during the Survey, reviewed the preliminary reports, and provided critiques most useful in the preparation of this Working Paper series.

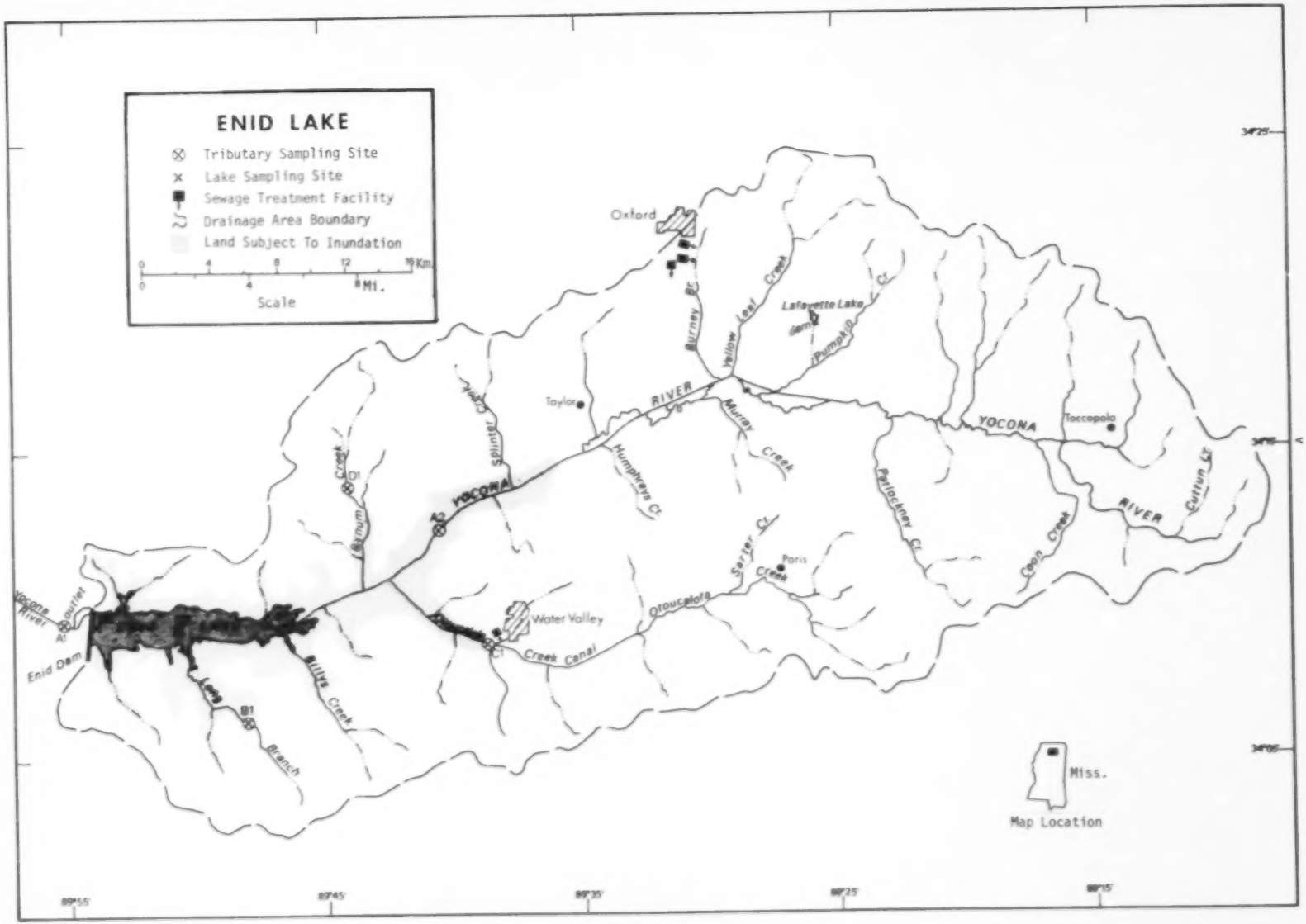
Major General E. A. Beby Turnage, the Adjutant General of Mississippi, and Project Officer Major Thomas D. Nichols, who directed the volunteer efforts of the Mississippi National Guardsmen, are also gratefully acknowledged for their assistance to the Survey.

NATIONAL EUTROPHICATION SURVEY

STUDY LAKES

STATE OF MISSISSIPPI

LAKE NAME	COUNTY
Arkabutla	DeSoto, Tate
Enid	Yalobusha
Grenada	Calhoun, Grenada, Yalobusha
Pickwick	Tishominga
Ross Barnett	Jackson, Madison, Rankin
Sardis	Lafayette, Panola


ENID LAKE
Tributary Sampling Site
Lake Sampling Site
Sewage Treatment Facility
Drainage Area Boundary
Land Subject To Inundation
0 4 8 12 16 Km.
0 4 8 Mi.
Scale
Oxford
Lafayette Lake
dam
Burney Br.
Yellow Leaf Creek
Pumpkin Cr.
Taylor
YOCONA RIVER
Murray Creek
Humphreys Cr.
Splinters Creek
Batumka Creek
YOCONA
Toccopola
Cotton Cr.
Cypress Creek
Paris Creek
Water Valley
Otoucalofa Creek Canal
Yocona River
Enid Dam
Little Creek
Branch
Miss.
Map Location
34°25'
34°15'
34°05'
89°55'
89°45'
89°35'
89°25'
89°15'

ENID LAKE

STORET NO. 2802

I. CONCLUSIONS

A. Trophic Condition:

Survey data indicate that Enid Lake is eutrophic. It ranked fourth in overall trophic quality when the five Mississippi lakes sampled in 1973 were compared using a combination of six parameters*. Three of the lakes had less median total phosphorus, one had less and one had the same median dissolved phosphorus, two had less median inorganic nitrogen, three had less mean chlorophyll a, and two had greater mean Secchi disc transparency. Depression of dissolved oxygen with depth occurred at all three sampling stations in June and at stations 2 and 3 in August.

Survey limnologists reported a muddy, brown-green appearance in June of the sampling year.

B. Rate-Limiting Nutrient:

The algal assay results indicate that Enid Lake was phosphorus limited at the time the sample was collected (06/12/73). The lake data indicate phosphorus limitation at the other sampling times as well.

C. Nutrient Controllability:

1. Point sources--The estimated phosphorus contribution of the known point sources amounted to only 4.6% of the total reaching

* See Appendix A.

Enid Lake during the sampling year. The point sources included the communities of Water Valley (1.8%), Oxford South Plant-East and West Lagoons (2.7%), and Oxford Little Lagoon (0.1%). However, the phosphorus export rates of two of the tributaries were quite high, and it is possible that additional point sources in the Water Valley and Oxford areas contributed to the loadings (see below).

The present phosphorus loading of 3.98 g/m^2/year is over five times that proposed by Vollenweider (Vollenweider and Dillon, 1974) as a eutrophic loading (see page 13). However, Enid Lake is phosphorus limited, and all phosphorus inputs to the lake should be minimized to the greatest practicable extent to slow the aging of this water body.

2. Non-point sources--It is calculated that over 95% of the total phosphorus input to Enid Lake was contributed by non-point sources during the sampling year. After point-source loads were subtracted, the Otoucalofa Creek Canal contributed 52.2%, and the Yocona River Canal contributed 38.3% of the total phosphorus load. Other contributing gaged tributaries were Bynum Creek (1.7%) and Long Branch (1.5%). Ungaged tributaries were estimated to have contributed 1.2% of the overall phosphorus load.

The phosphorus export rate of the Otoucalofa Creek Canal was a very high 360 kg/km^2 during the sampling year (see page 12).

This high rate may be the result of underestimation of the Water Valley load since more than 25% of the waste load to the plant was contributed by the poultry-processing industry (Murphy, 1973). Also, sampling site C-1 may have been too close to the Water Valley treatment plant discharge (ca. 0.8 km) to permit adequate mixing of the effluent in the stream at the sampling point which could result in unusually high phosphorus concentrations in the samples (note that the mean phosphorus concentration in this stream was from about four to over eight times higher than the mean concentrations in the other sampled tributaries).

The phosphorus export rate of the Yocona River Canal also was somewhat high (89 $kg/km^2/yr$). This may have resulted from underestimation of the phosphorus contributions of the Oxford wastewater treatment ponds or, possibly, unsampled point sources (e.g., Toccopola and Taylor).

II. LAKE AND DRAINAGE BASIN CHARACTERISTICS†

A. Lake Morphometry††:

1. Surface area: 52.49 kilometers^2.
2. Mean depth: 15.5 meters.
3. Maximum depth: 22.5 meters.
4. Volume: 813.595 x 10^6 m^3.
5. Mean hydraulic retention time: 1.12 years (based on outflow).

B. Tributary and Outlet:
(See Appendix C for flow data)

1. Tributaries -

Name	Drainage area (km^2)*	Mean flow (m^3/sec)*
Yocona River Canal	898.7	13.7
Long Branch	71.7	1.0
Otoucalofa Creek Canal	303.0	4.9
Bynum Creek	71.5	1.1
Minor tributaries & immediate drainage -	53.0	1.3
Totals	1,397.9	22.0

2. Outlet -

Yocona River Canal	1,450.4**	23.0

C. Precipitation***:

1. Year of sampling: 205.0 centimeters.
2. Mean annual: 135.7 centimeters.

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† Table of metric conversions--Appendix B.
†† Smith, 1973.
* For limits of accuracy, see Working Paper No. 175, "...Survey Methods, 1973-1976".
** Includes area of lake.
*** See Working Paper No. 175.

III. LAKE WATER QUALITY SUMMARY

Enid Lake was sampled three times during the open-water season of 1973 by means of a pontoon-equipped Huey helicopter. Each time, samples for physical and chemical parameters were collected from three stations on the lake and from a number of depths at each station (see map, page v). During each visit, a single depth-integrated (4.6 m or near bottom to surface) sample was composited from the stations for phytoplankton identification and enumeration; and during the first visit, a single 18.9-liter depth-integrated sample was composited for algal assays. Also each time, a depth-integrated sample was collected from each of the stations for chlorophyll a analysis. The maximum depths sampled were 6.4 meters at station 1, 12.8 meters at station 2, and 14.0 meters at station 3.

The sampling results are presented in full in Appendix D and are summarized in the following table.

A. SUMMARY OF PHYSICAL AND CHEMICAL CHARACTERISTICS FOR ENID LAKE
STORET CODE 2802

PARAMETER	1ST SAMPLING (6/12/73) 3 SITES RANGE	MEAN	MEDIAN	2ND SAMPLING (8/27/73) 3 SITES RANGE	MEAN	MEDIAN	3RD SAMPLING (11/ 1/73) 3 SITES RANGE	MEAN	MEDIAN
TEMP (C)	17.5 - 30.5	24.6	24.1	19.6 - 30.4	27.4	28.9	15.5 - 18.1	17.2	17.6
DISS OXY (MG/L)	1.0 - 7.8	4.5	4.2	0.1 - 8.8	5.0	7.0	7.2 - 9.2	8.1	8.2
CNDCTVY (MCROMO)	37. - 48.	40.	39.	53. - 99.	67.	58.	43. - 46.	45.	45.
PH (STAND UNITS)	5.7 - 7.8	6.7	6.4	6.1 - 6.9	6.5	6.6	7.6 - 7.7	7.6	7.6
TOT ALK (MG/L)	13. - 18.	15.	15.	14. - 31.	19.	17.	12. - 16.	15.	15.
TOT P (MG/L)	0.060 - 0.149	0.074	0.066	0.015 - 0.117	0.041	0.025	0.050 - 0.118	0.073	0.055
ORTHO P (MG/L)	0.005 - 0.078	0.013	0.008	0.004 - 0.022	0.008	0.005	0.010 - 0.017	0.013	0.014
NO2+NO3 (MG/L)	0.090 - 0.310	0.174	0.160	0.040 - 0.110	0.066	0.060	0.110 - 0.170	0.140	0.130
AMMONIA (MG/L)	0.080 - 0.230	0.131	0.130	0.040 - 0.790	0.217	0.060	0.080 - 0.100	0.092	0.090
KJEL N (MG/L)	0.300 - 1.200	0.479	0.300	0.600 - 1.500	0.918	0.800	0.300 - 0.700	0.470	0.450
INORG N (MG/L)	0.170 - 0.440	0.306	0.305	0.080 - 0.900	0.284	0.120	0.200 - 0.270	0.232	0.220
TOTAL N (MG/L)	0.420 - 1.300	0.653	0.555	0.640 - 1.610	0.985	0.840	0.430 - 0.810	0.610	0.600
CHLRPYL A (UG/L)	2.2 - 4.2	3.4	3.8	5.9 - 6.8	6.3	6.1	5.8 - 17.3	10.1	7.1
SECCHI (METERS)	0.7 - 0.8	0.7	0.8	1.2 - 1.4	1.3	1.4	0.5 - 0.8	0.6	0.5

B. Biological characteristics:

1. Phytoplankton -

Sampling Date	Dominant Genera	Algal Units per ml
06/12/73	1. Melosira sp.	194
	2. Aphanizomenon sp.	65
	3. Cyclotella sp.	39
	4. Flagellates	39
	5. Coelastrum sp.	26
	Other genera	102
	Total	465
08/27/73	1. Lyngbya sp.	1,124
	2. Aphanizomenon sp.	319
	3. Cryptomonas sp.	243
	4. Melosira sp.	167
	5. Synedra sp.	137
	Other genera	318
	Total	2,308
11/01/73	1. Melosira sp.	1,459
	2. Pennate diatoms	307
	3. Cyclotella sp.	179
	4. Dactylococcopsis sp.	102
	5. Aphanizomenon sp.	51
	Other genera	103
	Total	2,201

2. Chlorophyll a -

Sampling Date	Station Number	Chlorophyll a (µg/l)
06/12/73	01	2.2
	02	3.8
	03	4.2
08/27/73	01	5.9
	02	6.1
	03	6.8
11/01/73	01	17.3
	02	7.1
	03	5.8

C. Limiting Nutrient Study:

1. Autoclaved, filtered, and nutrient spiked -

Spike (mg/l)	Ortho P Conc. (mg/l)	Inorganic N Conc. (mg/l)	Maximum yield (mg/l-dry wt.)
Control	0.010	0.724	0.1
0.050 P	0.060	0.724	2.1
0.050 P + 1.0 N	0.060	1.724	15.4
1.0 N	0.010	1.724	0.1

2. Discussion -

The control yield of the assay alga, Selenastrum capricornutum, indicates that the potential primary productivity of Enid Lake was low at the time the sample was collected (06/12/73). The results also indicate the lake was phosphorus limited at that time. Note that the addition of orthophosphorus alone produced a significant increase in yield over that of the control, whereas addition of nitrogen alone produced no such increase.

The lake data also indicate limitation by phosphorus. The mean inorganic nitrogen/orthophosphorus ratios were 18/1 or greater at all sampling stations and times, and phosphorus limitation would be expected.

IV. NUTRIENT LOADINGS
(See Appendix E for data)

For the determination of nutrient loadings, the Mississippi National Guard collected monthly a near-surface grab sample from each of the tributary sites indicated on the map (page v) in August, September, November, and January (floods prevented sampling during much of the Survey year). Sampling was begun in August, 1973, and was completed in January, 1974.

Through an interagency agreement, stream flow estimates for the year of sampling and a "normalized" or average year were provided by the Mississippi District Office of the U.S. Geological Survey for the tributary sites nearest the lake.

In this report, nutrient loads for sampled tributaries were determined by using a modification of a U.S. Geological Survey computer program for calculating stream loadings*. Nutrient loads shown are those measured minus point-source loads, if any.

Nutrient loads for unsampled "minor tributaries and immediate drainage" ("ZZ" of U.S.G.S.) were estimated using the means of the nutrient loads, in $kg/km^2/year$, at stations B-1 and D-1 and multiplying the means by the ZZ area in km^2.

The operators of the three Oxford wastewater treatment plants provided monthly effluent samples but only limited flow data, and the operator of the Water Valley wastewater treatment plant provided monthly

* See Working Paper No. 175.

samples but no flow data. Therefore, nutrient loads from these sources were estimated at 1.134 kg P and 3.401 kg N/capita/year.

A. Waste Sources:

1. Known municipal† -

Name	Pop. Served	Treatment	Mean Flow (m^3/d)	Receiving Water
Oxford -				
South Plant				
East Lagoon West Lagoon	} 5,000	lagoon	1,892.5*	Burney Branch
Little Lagoon	200	lagoon	75.7*	Goose Creek
Water Valley**	3,300	lagoon	1,608.6	Town Creek

2. Known industrial - None with separate treatment facilities.

† Murphy, 1973.
* Estimated at 0.3785 m^3/capita/day.
** Over 25% of total waste load from industry (poultry processing); Murphy, op. cit.

B. Annual Total Phosphorus Loading - Average Year:

1. Inputs -

Source	kg P/ yr	% of total
a. Tributaries (non-point load) -		
Yocona River Canal	79,935	38.3
Long Branch	3,075	1.5
Otoucalofa Creek Canal	109,090	52.2
Bynum Creek	3,635	1.7
b. Minor tributaries & immediate drainage (non-point load) -	2,490	1.2
c. Known municipal STP's -		
Oxford -		
South Plant	5,670	2.7
Little Lagoon	225	0.1
Water Valley	3,740	1.8
d. Septic tanks* -	15	<0.1
e. Known industrial - None	-	-
f. Direct precipitation** -	920	0.4
Total	208,795	100.0

2. Outputs -

Lake outlet - Yocona R. Canal 45,100

3. Net annual P accumulation - 163,695 kg.

* Estimate based on 22 lakeside dwellings and 11 parks; see Working Paper No. 175.
** See Working Paper No. 175.

C. Annual Total Nitrogen Loading - Average Year:

1. Inputs -

Source	kg N/yr	% of total
a. Tributaries (non-point load) -		
Yocona River Canal	475,760	37.8
Long Branch	55,795	4.4
Otoucalofa Creek Canal	557,220	44.3
Bynum Creek	45,400	3.6
b. Minor tributaries & immediate drainage (non-point load) -	37,445	3.0
c. Known municipal STP's -		
Oxford -		
South Plant	17,005	1.4
Little Lagoon	680	<0.1
Water Valley	11,225	0.9
d. Septic tank* -	625	<0.1
e. Known industrial - None	-	-
f. Direct precipitation** -	56,670	4.5
Total	1,257,825	100.0

2. Outputs -

Lake outlet - Yocona R. Canal 589,125

3. Net annual N accumulation - 668,700 kg.

D. Mean Annual Non-point Nutrient Export by Subdrainage Area:

Tributary	kg P/km^2/yr	kg N/km^2/yr
Yocona River Canal	89	529
Long Branch	43	778
Otoucalofa Creek Canal	360	1,839
Bynum Creek	51	635

* Estimate based on 22 lakeside dwellings and 11 parks; see Working Paper No. 175.
** See Working Paper No. 175.

E. Yearly Loads:

In the following table, the existing phosphorus loadings are compared to those proposed by Vollenweider (Vollenweider and Dillon, 1974). Essentially, his "dangerous" loading is one at which the receiving water would become eutrophic or remain eutrophic; his "permissible" loading is that which would result in the receiving water remaining oligotrophic or becoming oligotrophic if morphometry permitted. A mesotrophic loading would be considered one between "dangerous" and "permissible".

Note that Vollenweider's model may not be applicable to water bodies with short hydraulic retention times.

	Total Phosphorus		Total Nitrogen	
	Total	Accumulated	Total	Accumulated
grams/m^2/yr	3.98	3.12	24.0	12.7

Vollenweider phosphorus loadings ($g/m^2/yr$) based on mean depth and mean hydraulic retention time of Enid Lake:	
"Dangerous" (eutrophic loading)	0.72
"Permissible" (oligotrophic loading)	0.36

V. LITERATURE REVIEWED

Murphy, W. Carroll, 1973. Treatment plant questionnaires. MS Air & Water Poll. Contr. Comm., Jackson.

Smith, John, 1973. Personal communication (lake morphometry). MS Air & Water Poll. Contr. Comm., Jackson.

Vollenweider, R. A., and P. J. Dillon, 1974. The application of the phosphorus loading concept to eutrophication research. Natl. Res. Council of Canada Publ. No. 13690, Canada Centre for Inland Waters, Burlington, Ontario.

VI. APPENDICES

APPENDIX A

LAKE RANKINGS

LAKE DATA TO BE USED IN RANKINGS

LAKE CODE	LAKE NAME	MEDIAN TOTAL P	MEDIAN INORG N	500-MEAN SEC	MEAN CHLORA	15-MIN DO	MEDIAN DISS ORTHO P
2801	ARKABUTLA LAKE	0.198	0.440	485.111	6.500	15.000	0.025
2802	ENID LAKE	0.062	0.240	465.000	6.578	14.900	0.009
2804	ROSS BARNETT RESERVOIR	0.045	0.140	462.917	9.992	14.600	0.008
2805	SARDIS LAKE	0.041	0.190	447.750	6.425	14.800	0.009
2806	GRENADA LAKE	0.051	0.305	476.778	6.022	14.900	0.010

PERCENT OF LAKES WITH HIGHER VALUES (NUMBER OF LAKES WITH HIGHER VALUES)

LAKE CODE	LAKE NAME	MEDIAN TOTAL P	MEDIAN INORG N	500-MEAN SEC	MEAN CHLORA	15-MIN DO	MEDIAN DISS ORTHO P	INDEX NO
2801	ARKABUTLA LAKE	0 (0)	0 (0)	0 (0)	50 (2)	0 (0)	0 (0)	50
2802	ENID LAKE	25 (1)	50 (2)	50 (2)	25 (1)	38 (1)	63 (2)	251
2804	ROSS BARNETT RESERVOIR	75 (3)	100 (4)	75 (3)	0 (0)	100 (4)	100 (4)	450
2805	SARDIS LAKE	100 (4)	75 (3)	100 (4)	75 (3)	75 (3)	63 (2)	488
2806	GRENADA LAKE	50 (2)	25 (1)	25 (1)	100 (4)	38 (1)	25 (1)	263

LAKES RANKED BY INDEX NOS.

RANK	LAKE CODE	LAKE NAME	INDEX NO
1	2805	SARDIS LAKE	488
2	2804	ROSS BARNETT RESERVOIR	450
3	2806	GRENADA LAKE	263
4	2802	ENID LAKE	251
5	2801	ARKABUTLA LAKE	50

APPENDIX B

CONVERSION FACTORS

CONVERSION FACTORS

Hectares x 2.471 = acres

Kilometers x 0.6214 = miles

Meters x 3.281 = feet

Cubic meters x 8.107×10^{-4} = acre/feet

Square kilometers x 0.3861 = square miles

Cubic meters/sec x 35.315 = cubic feet/sec

Centimeters x 0.3937 = inches

Kilograms x 2.205 = pounds

Kilograms/square kilometer x 5.711 = lbs/square mile

APPENDIX C

TRIBUTARY FLOW DATA

TRIBUTARY FLOW INFORMATION FOR MISSISSIPPI 02/18/76

LAKE CODE 2802 ENID LAKE

TOTAL DRAINAGE AREA OF LAKE(SQ KM) 1450.4

TRIBUTARY	SUB-DRAINAGE AREA(SQ KM)	NORMALIZED FLOWS(CMS) JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	MEAN
2802A1	1450.4	36.87	35.71	39.33	28.18	18.86	16.91	17.53	16.65	16.28	14.47	13.71	22.77	23.05
2802A2	898.7	22.09	28.60	30.02	25.77	12.01	6.65	4.96	2.89	5.44	2.63	9.46	14.58	13.66
2802B1	71.7	1.84	2.41	2.52	2.15	0.93	0.34	0.20	0.05	0.24	0.04	0.76	1.13	1.04
2802C1	303.0	7.48	9.74	10.19	8.72	4.28	2.58	2.10	1.47	2.24	1.36	3.74	5.04	4.88
2802D1	71.5	1.73	2.27	2.66	2.04	0.93	0.48	0.37	0.20	0.40	0.18	0.76	1.16	1.09
2802ZZ	82.9	2.04	2.66	2.80	2.38	1.13	0.62	0.48	0.28	0.51	0.25	0.91	1.36	1.28

SUMMARY

TOTAL DRAINAGE AREA OF LAKE = 1450.4
SUM OF SUB-DRAINAGE AREAS = 1427.9

TOTAL FLOW IN = 265.24
TOTAL FLOW OUT = 277.25

MEAN MONTHLY FLOWS AND DAILY FLOWS(CMS)

TRIBUTARY	MONTH	YEAR	MEAN FLOW	DAY	FLOW	DAY	FLOW	DAY	FLOW
2802A1	8	73	70.37	22	69.38				
	9	73	53.69	9	65.13				
	11	73	26.08	10	15.57				
	1	74	55.08	20	82.12				
2802A2	8	73	3.54	22	1.95				
	9	73	2.27	9	3.45				
	11	73	32.56	10	11.89				
	1	74	76.46	20	27.18				
2802B1	8	73	0.09	22	0.02				
	9	73	0.03	9	0.08				
	11	73	2.61	10	0.91				
	1	74	6.14	20	2.21				
2802C1	8	73	1.64	23	1.10				
	9	73	1.22	9	1.61				
	11	73	11.04	10	4.11				
	1	74	26.19	20	9.34				
2802D1	8	73	0.22	22	0.13				
	9	73	0.15	9	0.24				
	11	73	2.52	10	0.88				
	1	74	6.09	20	2.18				
2802ZZ	8	73	0.34	22	0.20				
	9	73	0.23	9	0.34				
	11	73	3.00	10	1.08				
	1	74	7.05	20	2.52				

APPENDIX D

PHYSICAL and CHEMICAL DATA

STORET RETRIEVAL DATE 76/02/18

280201
34 08 52.0 089 47 22.0 3
ENID LAKE
28161 MISSISSIPPI

11EPALES 2111202
0025 FEET DEPTH CLASS 00

DATE FROM TO	TIME OF DAY	DEPTH FEET	00010 WATER TEMP CENT	00300 DO MG/L	00077 TRANSP SECCHI INCHES	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU	00410 T ALK CACO3 MG/L	00610 NH3-N TOTAL MG/L	00625 TOT KJEL N MG/L	00630 NO2&NO3 N-TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P
73/06/12	15 00	0000	28.3		28	39	6.90J	15	0.130	0.800	0.100	0.078
	15 00	0006	27.8	6.9		38	6.60J	13	0.100	0.300	0.120	0.007
	15 00	0015	24.0	4.0		42	6.00J	13	0.160	0.300	0.160	0.005
	15 00	0021	21.8	1.0		48	5.70J	16	0.230	0.400	0.160	0.006
73/08/27	19 00	0000	30.0	8.8	48	59	6.80	15	0.070	0.900	0.060	0.005
	19 00	0005	29.2	7.0		56	6.90	15	0.040	0.600	0.040	0.005
	19 00	0015	27.4	7.0		59	6.50	20	0.150	0.600	0.090	0.009
73/11/01	15 50	0000	15.5		18	43	7.60	13	0.090	0.700	0.110	0.017
	15 50	0001	15.5	9.2		43	7.60	13	0.090	0.600	0.120	0.012
	15 50	0004	15.5	9.2		43	7.60	12	0.100	0.600	0.120	0.014

DATE FROM TO	TIME OF DAY	DEPTH FEET	00665 PHOS-TOT MG/L P	32217 CHLRPHYL A UG/L
73/06/12	15 00	0000	0.149	2.2
	15 00	0006	0.065	
	15 00	0015	0.066	
	15 00	0021	0.077	
73/08/27	19 00	0000	0.033	5.9
	19 00	0005	0.019	
	19 00	0015	0.047	
73/11/01	15 50	0000	0.113	17.3
	15 50	0001	0.118	
	15 50	0004	0.116	

J VALUE KNOWN TO BE IN ERROR

STORET RETRIEVAL DATE 76/02/18

280202
34 09 00.0 089 50 55.0 3
ENID LAKE
28161 MISSISSIPPI

11EPALES 2111202
0045 FEET DEPTH CLASS 00

DATE FROM TO	TIME OF DAY	DEPTH FEET	00010 WATER TEMP CENT	00300 DO MG/L	00077 TRANSP SECCHI INCHES	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU	00410 T ALK CACO3 MG/L	00610 NH3-N TOTAL MG/L	00625 TOT KJEL N MG/L	00630 NO2&NO3 N-TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P
73/06/12	15 40	0000	30.3		30	37	7.70J	17	0.140	1.100	0.100	0.008
	15 40	0006	27.0	7.3		38	7.30J	15	0.100	0.400	0.120	0.010
	15 40	0015	23.8	4.7		39	6.30J	14	0.120	0.300	0.170	0.008
	15 40	0030	20.3	3.0		41	6.20J	14	0.140	0.300	0.280	0.010
	15 40	0041	19.1	2.7		44	6.10J	14	0.100	0.300	0.280	0.012
73/08/27	19 15	0000	29.8	7.2	55	58	6.60	16	0.040	0.800	0.040	0.004
	19 15	0015	28.9	4.4		53	6.20	14	0.060	0.600	0.040	0.005
	19 15	0030	23.8	0.1		99	6.10	24	0.550	1.400	0.100	0.015
	19 15	0042	19.6	0.2		90	6.30	31	0.790	1.500	0.110	0.022
73/11/01	15 40	0000	17.6		32	45	7.60	16	0.080	0.500	0.130	0.010
	15 40	0005	17.6	8.2		45	7.60	14	0.090	0.400	0.130	0.015
	15 40	0013	17.6	8.2		44	7.60	14	0.090	0.300	0.130	0.015

DATE FROM TO	TIME OF DAY	DEPTH FEET	00665 PHOS-TOT MG/L P	32217 CHLRPHYL A UG/L
73/06/12	15 40	0000	0.066	3.8
	15 40	0006	0.060	
	15 40	0015	0.064	
	15 40	0030	0.071	
	15 40	0041	0.076	
73/08/27	19 15	0000	0.015	6.1
	19 15	0015	0.025	
	19 15	0030	0.078	
	19 15	0042	0.117	
73/11/01	15 40	0000	0.052	7.1
	15 40	0005	0.052	
	15 40	0013	0.062	

J VALUE KNOWN TO BE IN ERROR

STORET RETRIEVAL DATE 76/02/18

280203
34 08 58.0 089 54 08.0 3
ENID LAKE
28161 MISSISSIPPI

11EPALES 2111202
0050 FEET DEPTH CLASS 00

DATE FROM TO	TIME OF DAY	DEPTH FEET	00010 WATER TEMP CENT	00300 DO MG/L	00077 TRANSP SECCHI INCHES	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU	00410 T ALK CACO3 MG/L	00610 NH3-N TOTAL MG/L	00625 TOT KJEL N MG/L	00630 NO2&NO3 N-TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P
73/06/12	16 15	0000	30.5		30	37	7.80J	18	0.150	1.200	0.100	0.006
	16 15	0006	29.5	7.8		38	7.80J	17	0.080	0.400	0.090	0.005
	16 15	0015	24.3	5.4		39	6.50J	16	0.150	0.300	0.200	0.006
	16 15	0030	20.5	4.2		40	6.30J	15	0.110	0.300	0.250	0.009
	16 15	0046	17.5	2.6		43	6.20J	17	0.130	0.300	0.310	0.010
73/08/27	19 40	0000	30.4	7.8	56	58	6.70	17	0.050	0.900	0.050	0.005
	19 40	0010	30.4	7.6		56	6.80	18	0.060	0.700	0.060	0.006
	19 40	0020	28.6	4.4		53	6.60	17	0.060	0.700	0.050	0.004
	19 40	0030	23.2	0.4		95	6.20	27	0.520	1.400	0.090	0.007
73/11/01	15 18	0000	18.1		18	46	7.70	16	0.100	0.500	0.160	0.014
	15 18	0005	18.1	7.4		46	7.60	15	0.100	0.400	0.170	0.013
	15 18	0015	18.1	7.4		46	7.60	16	0.090	0.300	0.170	0.014
	15 18	0023	18.0	7.2		45	7.60	16	0.090	0.400	0.160	0.011

DATE FROM TO	TIME OF DAY	DEPTH FEET	00665 PHOS-TOT MG/L P	32217 CHLRPHYL A UG/L
73/06/12	16 15	0000	0.065	4.2
	16 15	0006	0.061	
	16 15	0015	0.066	
	16 15	0030	0.069	
	16 15	0046	0.080	
73/08/27	19 40	0000	0.024	6.8
	19 40	0010	0.022	
	19 40	0020	0.024	
	19 40	0030	0.049	
73/11/01	15 18	0000	0.056	5.8
	15 18	0005	0.054	
	15 18	0015	0.050	
	15 18	0023	0.053	

J VALUE KNOWN TO BE IN ERROR

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APPENDIX E

TRIBUTARY and WASTEWATER TREATMENT PLANT DATA

STORET RETRIEVAL DATE 76/02/23

2802A1
34 08 50.0 089 55 15.0 4
YOCONA CANAL
28033 15 OAKLAND
O/ENID LAKE
HWY 51 BRDG BELO ENID DAM
11EPALES 2111204
0000 FEET DEPTH CLASS 00

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
73/08/22	14 10		0.016	1.050	0.320	0.010	0.045
73/09/09	13 40		0.370	0.400	0.126	0.010	0.035
73/11/10	15 43		0.220	0.850	0.132	0.018	
74/01/20	14 00		0.200	0.400	0.105	0.055	0.115

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STORET RETRIEVAL DATE 76/02/23

2802A2
34 12 15.0 089 40 45.0 4
YOCONA RIVER CANAL
28 15 WATER VALLY
I/ENID LAKE
HWY 315 BRDG 4 MI NW OF WATER VALLY
11EPALES 2111204
0000 FEET DEPTH CLASS 00

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
73/08/22	12 20		0.120	0.700	0.025	0.018	0.175
73/09/09	13 00		0.390	0.690	0.079	0.050	0.190
73/11/10	14 55		0.120	1.900	0.380	0.040	0.315
74/01/20	13 00		0.132	0.300	0.075	0.025	0.090

STORET RETRIEVAL DATE 76/02/23

280281
34 05 57.0 089 48 05.0 4
LONG BRANCH
28 15 OAKLAND
T/ENID LAKE
OAKLAND RD BRDG 1.5 MI S OF FORDS WELL
11EPALES 2111204
0000 FEET DEPTH CLASS 00

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
73/08/22	15	38	0.030	1.230	0.295	0.005K	0.030
73/09/09	14	10	0.082	1.400	0.042	0.012	0.050
73/11/10	16	00	0.060	2.600	0.330	0.021	0.123
74/01/20	14	45	0.112	0.400	0.030	0.020	0.140

K VALUE KNOWN TO BE
LESS THAN INDICATED

-30-

STORET RETRIEVAL DATE 76/02/23

2802C1
34 08 35.0 089 39 00.0 4
OTOUCALOFA CREEK CANAL
28 15 WATER VALLY
T/ENID LAKE
BANK .5 MI SW OF WATER VALLEY BELO STP
11EPALES 2111204
0000 FEET DEPTH CLASS 00

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
73/08/23	10 00		0.176	4.600	0.660	0.294	0.850
73/09/09	14 40		0.320	3.400	1.370	0.320	0.720
73/11/10	14 25		0.280	4.400	1.000	0.425	1.050
74/01/20	15 30		0.152	1.000	0.125	0.055	0.250

STORET RETRIEVAL DATE 76/02/23

2802D1
34 13 30.0 089 44 25.0 4
BYNUM CREEK
28 15 WATER VALLY
T/ENID LAKE
ST HWY 315 BRDG 1 MI N OF BYNUM SCHOOL
11EPALES 2111204
0000 FEET DEPTH CLASS 00

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
73/08/22	18 00		0.039	1.050	0.399	0.017	0.115
73/09/09	13 10		0.044	0.425	0.034	0.023	0.070
73/11/10	15 08		0.072	2.600	0.320	0.034	0.125
74/01/20	13 15		0.112	0.600	0.060	0.020	0.095

STORET RETRIEVAL DATE 76/02/18

2802CA PD2802CA P003300*
34 08 30.0 089 39 00.0 4
WATER VALLEY
28033 TALOBUSHA CO MAP
T/ENID CREEK
OTOUCALOFA CR CANAL
11EPALES 2141204
0000 FEET DEPTH CLASS 00

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P	50051 FLOW RATE INST MGD	50053 CONDUIT FLOW-MGD MONTHLY
73/05/15	13 20		0.035	36.000	17.600	4.200	6.800		
73/06/15	14 15		0.165	37.800	10.200	0.450	6.500		
73/07/20	10 00		0.070	36.900	3.300	1.340	6.700		
73/08/15	10 00		0.189	15.000	1.200	0.580	6.300		
73/09/17	10 00		0.067	28.000	4.700	2.300	6.700		
73/10/15	09 00		0.056	31.000	4.600	2.800	6.300		
73/11/15	08 30		0.040	31.000	3.990	2.310	5.900		
73/12/24	08 30		0.330	31.000	8.100	3.300	5.700		
74/01/14	08 30		0.160	17.000	4.300	2.200	4.200		
74/02/21	22 00		0.120	26.000	8.600	3.300	6.000		
74/03/19	14 00		0.320	37.000	17.300	4.700	7.300		
74/04/16	13 15		0.080	23.000	18.000	5.000	6.300		
74/05/28	08 25		0.280	31.000	9.000	2.800	4.800		

STORET RETRIEVAL DATE 76/02/18

280221 P0280221 P005000
34 20 30.0 089 31 00.0 4
OXFORD
28161 7.5 OXFORD
T/ENID LAKE
BURNEY BRANCH
11EPALES 2141204
0000 FEET DEPTH CLASS 00

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P	50051 FLOW RATE INST MGD	50053 CONDUIT FLOW-MGD MONTHLY
73/05/10	08 00		0.130	11.500	1.900	4.600	5.600		
73/06/11	08 30		0.017	6.100	0.056	4.850	5.550		
73/07/10	08 00		0.030	5.600	0.069	5.300	5.800		
73/08/13	08 00		0.070	2.100	0.210	3.400	6.900		
73/09/12	08 30		0.048	7.300	1.340	6.400	7.200	0.250	0.250
73/10/12	09 30		0.030	10.000	3.000	6.600	7.600	0.250	
73/11/12	09 15		0.180	12.500	3.700	6.300	7.600	0.250	
73/12/06	09 15		0.400	9.000	3.150	5.300	6.100		
74/01/17	13 15		0.160	9.600	0.088	4.300	5.400		
74/02/08	08 15		0.200	11.000	4.900	4.300	5.500		
74/03/08	09 15		0.040	11.000	5.000	4.800	6.000		
74/04/17	09 15		0.120	26.000	4.600	6.300	9.500		
74/05/08	08 45		0.160	9.000	2.200	4.800	6.000		

STORET RETRIEVAL DATE 76/02/18

280222 PD280222 P005000
34 20 30.0 089 31 00.0 4
OXFORD
28 7.5 OXFORD
T/ENID LAKE
BURNEY BRANCH
11EPALES 2141204
0000 FEET DEPTH CLASS 00

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P	50051 FLOW RATE INST MGD	50053 CONDUIT FLOW-MGD MONTHLY
73/05/10	08	15	0.085	10.000	2.400	4.900	5.500		
73/06/11	08	15	0.020	8.600	0.510	6.300	7.200		
73/07/10	08	15	0.020	8.300	0.890	6.900	7.800		
73/08/13	08	15	0.040	9.000	0.810	4.100	8.500		
73/09/12	08	15	0.048	10.000	1.240	7.780	8.800	0.250	0.250
73/10/12	09	15	0.150	4.700	1.760	6.612	13.000	0.250	
73/11/12	10	00	1.260	8.100	0.380	6.600	7.300	0.250	
73/12/06	10	00	0.310	3.800	0.077	4.400	5.100		
74/01/17	13	30	0.240	5.500	3.440	3.300	3.700		
74/02/08	08	00	0.080	11.000	5.300	4.000	5.300		
74/03/08	09	00	0.120	13.000	3.700	5.100	7.000		
74/04/17	09	30	0.040	19.000	7.100	5.400	7.800		
74/05/08			0.080	11.000	2.400	5.400	7.200		

STORET RETRIEVAL DATE 76/02/18

280223 PD280223 P000200
34 20 30.0 089 31 00.0 4
OXFORD
28 7.5 OXFORD
T/ENID LAKE
BURNEY BRANCH
11EPALES 2141204
0000 FEET DEPTH CLASS 00

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P	50051 FLOW RATE INST MGD	50053 CONDUIT FLOW-MGD MONTHLY
73/05/10	08 20		0.210	12.600	1.800	4.500	6.100		
73/06/11	08 00		0.010K	11.700	0.920	6.900	8.600		
73/07/10	08 30		0.020	12.600	0.700	6.000	7.900		
73/08/13	08 30		0.020	12.600	1.300	5.300	8.900		
73/09/12	08 00		0.031	17.600	2.360	9.620	11.500	0.150	0.150
73/10/12	09 00		0.020	22.000	4.900	1.760		0.150	
73/11/12	09 30		0.110	15.500	3.900	9.800	11.300	0.150	
73/12/06	09 00		0.170	11.500	3.780	5.400	7.000		
74/01/17	13 45		0.080	32.000	10.600	4.700	10.000		
74/02/08	08 45		0.160	12.000	3.800	5.880	7.500		
74/03/08	09 30		0.280	10.000	2.750	5.700	7.350		
74/04/17	09 00		0.080	33.000	7.100	7.450	20.000		
74/05/08	08 30		0.040	19.000	3.600	6.700	9.800		